VERIFICATION OF TRANSLATION

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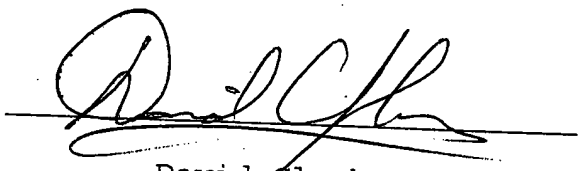
Signature 

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Interconnection Element For a Winding of an Electrical Machine

Prior Art

The invention is based on an interconnection element for a multiphase winding that is comprised of coils and is part of an electrical machine, in particular a brushless mini motor, as generically defined by the preamble to claim 1.

In a known interconnection element of this type (EP 1 062 720 B1), the support made of insulating material is embodied in the form of a supporting plate, which, together with a stator body that is embodied in the form of a lamination bundle and supports the winding, is fastened by means of a hub to a bearing support tube that is in turn attached to a motor flange. The electrical conducting strips for producing interconnections among the coils are embodied as conductor rails that are manufactured as stamped parts and are fastened to the supporting plate, concentric to the hub. A first conductor rail, which has tabs extending at angles in relation to the conductor rail to form a star point, is connected to the coil ends of all of the winding phases. Three other conductor rails are attached to the supporting plate, arranged concentrically around the first conductor rail, their tabs arrayed for connection to the coil beginnings. In order to avoid crossing points between the concentric rails and the tabs protruding from them, the tabs of the second conductor rail are routed under the third conductor rail and the fourth conductor rail by means of sunken guides in the supporting plate and the tabs of the third conductor rail are also routed under the fourth conductor rail by means of sunken guides. When manufacturing the conductor rails that are comprised of stamped material, in order to keep waste within limits, the first and third conductor rails are manufactured in a first stamping die and the second and fourth conductor rails are manufactured in a second stamping die, each in its own stamping procedure, the second, third, and

fourth conductor rails each being provided with a connecting tab for litz-connections.

Advantages of the Invention

The interconnection element according to the present invention, with the characteristics of claim 1 has the advantage that using bent wires for the electric conducting strips achieves a drastic reduction in the metal-related material costs for the interconnection element since in particular, this eliminates the enormous material waste generated by stamping, which can be up to 80% with the known interconnection element. The material waste is limited solely to the trimming of the wire ends possibly required by the manufacturing process. The substantial elimination of material waste also advantageously reduces disposal costs. Using simple wire-bending – the wires can have a round or polygonal cross section (rectangular, square, hexagonal, etc.) – makes it possible to replace stamping dies with inexpensive bending and handling tools. Plants that do not require a separate stamping station can manufacture the interconnection element according to the present invention by using the simple, inexpensive wire bending process, which can be implemented for only minimal investment costs, thus permitting companies to increase their real net output.

Advantageous modifications and improvements of the interconnection element disclosed in claim 1 are possible by means of the steps taken in the remaining claims 2 through 9.

According to an advantageous embodiment form of the present invention, the support is embodied in the form of a circular plastic ring with coaxial channels provided to accommodate the wires, which channels are partly open at the sides and are offset from one another, partly in the radial direction and partly in the axial direction. The circular plastic ring, whose radial width approximately corresponds to the radial thickness of the yoke ring of the stator of the motor, is

manufactured as an injection-molded part whose slender annular form further reduces materials costs in comparison to the supporting plate with the known interconnection element.

Claims 10 through 13 disclose a stator in which the interconnection element according to the present invention is used.

Drawings

The invention will be explained in greater detail in the description below in conjunction with an exemplary embodiment shown in the drawings.

Fig. 1 shows a perspective top view of an interconnection element for a winding in the stator of a brushless mini motor, in association with the stator,

Fig. 2 is a perspective, exploded view of the interconnection element according to Fig. 1,

Fig. 3 is a perspective, exploded bottom view of the interconnection element in Fig. 1.

Description of the Exemplary Embodiment

The interconnection element 10 shown in the perspective top view in Fig. 1 is conceived for a three-phase winding 11 with a total of nine coils 12 of a stator 13 of a brushless mini motor, which can be an electronically commutated direct current motor (EC motor) or a synchronous motor. The stator 13 depicted in a perspective view in Fig. 1 has a stator body 14, which, in an intrinsically known way, includes a hollow cylindrical yoke ring 15 and, in the exemplary embodiment, a total of nine stator teeth 16 protruding radially from it, which, with

a rotor that is not shown here, delimit the working air gap of the motor. An annular coil 12 is wound onto each stator tooth 16 and the coil ends 121 and 122 of each coil 12 are attached to a respective flat connecting pin 17. The connecting pins 17 are disposed equidistantly in the circumference direction and protrude axially from the end surface of the yoke ring 15; they are electrically insulated from the yoke ring 15 by an insulation ring 18.

The interconnection element 10 is used to produce interconnections among the coils 12; in the example described, the interconnections are laid out so that each phase belt or winding phase of the three-phase winding 11 has three coils 12 connected in parallel.

The interconnection element 10, an exploded view of which is shown from above in Fig. 2 and from below in Fig. 3, has an annular support 20 made of plastic that has a total of four coaxial channels 23 – 26, each for accommodating one of a total of four bent wires 27 through 30 that serve to interconnect the coils 12. Two channels 24 and 26 are radially offset in a plane of the support 20, i.e. are concentric to each other. The upper channel 23 and the lower channel 26 are axially offset in relation to the channels 24, 25 in the shared middle plane of the support 20 and have channel openings 231 and 261 in their outer annular wall. The upper channel 23 is also offset radially inward in relation to the channels 24 and 25. The corresponding bent wires 27 through 30 are accommodated in the channels 23 through 26 and are fixed therein by means of two annular cover elements 31, 32 made of plastic that are placed axially against the support 20 from above and below. The upper cover element 31 closes the upper channel 25 and, with axially downward-protruding closing bodies 33 that project radially beyond the cover element 31, partially covers the two middle channels 24, 25. The lower cover element 32 closes the lower channel 26 with the wire 30 contained therein and has downward-protruding bracing struts 34 disposed offset from one another on its circumference, which, when the interconnection element 10 is placed against the end surface of the yoke ring 15,

protrude between the wound stator teeth 16 and rest radially against the inner wall of the yoke ring 15 with frictional, nonpositive engagement. Both of the cover elements 31, 32 are fastened to the support 20, which can be carried out, for example, by means of clips, gluing, or ultrasonic welding.

A terminal strip 36 injection-molded out of plastic is placed against the support 20 and is equipped with three connecting terminals 37, 38, 39, each for one of the winding phases. The wire ends of the wires 27 through 29 are connected electrically and mechanically to the connecting terminals 37 through 39 by means of hot-stacking. In the course of the wires 27 through 30, bent segments 35 are provided, which serve to connect the wires 27 through 30 to the connecting pins 17 of the stator 13. In accordance with the three-phase wiring 11 in which each winding phase has three parallel coils 12, the wires 27 through 29 each have three bent segments 35 and the wire 30 has a total of nine bent segments 35 in order to produce a star point comprised of the winding phases. The bent segments 35 in the wires 28 and 29 that are contained in the two middle channels 24, 25 are routed radially over the channel rims of the channels 24, 25 to the connecting pins 17 and the bent segments 35 in the wires 27 and 30, which are contained in the upper channel 23 and the lower channel 26, are routed out the side through the channel openings 231 and 261 and are then bent axially in order to reach the plane of the connecting pins 17. The electrical connection between the bent segments 35 and the connecting pins 17 is produced by means of welding, soldering, or insulation displacement. In an alternative embodiment form, the connecting pins 17 can be eliminated and the coil ends 121, 122 can be welded directly to the bent segments 35.

The support 20 of the interconnection element 10 can have other attachment possibilities for add-on pieces. The bracing struts 34 simultaneously serve to center the interconnection element 10 in relation to the stator 13. In addition, fixing elements can be provided that automatically produce a correct

association of the bent segments 35 with the coil ends 121, 122 of the coil 12 when the interconnection element 10 is placed against the stator 13.

Naturally the above-described interconnection element is not limited solely to the interconnection of a three-phase winding with nine coils. With a corresponding adaptation of the number of bent wires and of the bent segments in the wires for connection to the coils, it is possible to interconnect any winding with any number of phases and coils.